

'Could Mercury be the Remnant Core of a once Hot Jupiter? A Grand Tack alternate scenario.'

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An alternate scenario of Dr. Kevin Walsh's Grand Tack Hypothesis of early Solar System formation is presented focusing primarily on resolving the many as yet unanswered questions regarding the observed anomalous aspects of Mercury by hypothesizing if Mercury was once a Hot Jupiter.

1. Introduction

Has anyone ever considered or excluded the possibility that Mercury might be a remnant core of a once Hot Jupiter? Briefly, here is the scenario. It checks off a lot of boxes in regards to answering the questions surrounding Mercury's many observed anomalies.

2. Grand Tack - An alternate scenario.

Early in Dr. Kevin Walsh's Grand Tack model¹, Jupiter and Saturn bring a smaller gas giant (Mercury) approximately the mass of Neptune or Uranus along for their inward migration towards the sun and use it as their gravitational sacrificial lamb (perhaps along with flinging a Planet 9 super-earth outward?). This should make Jupiter and Saturn's Grand Tack much more gravitationally plausible requiring much less mathematical fine tuning. The gas giant Mercury then spirals towards the sun shedding its atmosphere as it briefly plunges through the sun's corona burning the last of its atmosphere away. The resulting drag of the brief interaction of the sun's corona along with the loss of the mass of its atmosphere allows the now scorched oversized metallic core to slow and cool and settle into its anomalous orbital precession. Because it arrived in the inner solar system post Grand Tack it was only able to slowly accrete the leftover sun grazing comets and asteroids that brought the volatile organic molecules and ice over the next 3.5 - 4 billion years. This explains the undersized mass relative to the other rocky inner planets as well as its oversized metallic core with the extra thin rocky crust full of volatiles including ice. In this scenario, no crust or mass removing, volatile destroying, major collision with another small planet or moon ever occurred. The current estimated mass of Mercury's oversized metallic core should be used as a basis for the estimated mass of Mercury as a gas giant. In other words, don't forget to subtract the mass of that extra thin rocky crust from Mercury's current measured mass. In this scenario, that mass was obviously accreted post Grand Tack / gas giant phase.

3. Conclusion

Obviously more precise calculations and actual super-computer modelling will need to be conducted; as opposed to my thought experiment. Science is often about eliminating all the possibilities, but you can't eliminate something if you have never considered it. Hence the need to openly pose the question to the scientific community and to any planetary scientists that might be interested in continuing the research into answering the question; by either eliminating or confirming the hypothesis. Thank you for taking the time to read and consider my ideas. Please feel free to email me if you have any questions. I look forward to hearing from you. RCM.

4. References

1. Walsh, K., Morbidelli, A., Raymond, S. *et al.* A low mass for Mars from Jupiter's early gas-driven migration. *Nature* **475**, 206–209 (2011). <https://doi.org/10.1038/nature10201>