Asteroid geophysics from applying tidal theory to binary asteroids

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While the application of tidal theory to binary asteroids has been used in the past to deduce their geophysical properties, three important developments in the field have occurred: the discovery of the tidal-BYORP equilibrium end-state (Jacobson Scheeres 2011, Scheirich et al. 2015), the discovery of paired binary asteroids (Vokrouhlicky Nesvorny 2009, Pravec et al. 2013), and the development of a tidal theory based on a more sophisticated rheological model (Efroimsky 2012 and 2015). Using the most recent release of the Binary Asteroid Parameters database (Pravec et al. 2015) and selecting the known and suspected singly synchronous binary asteroids, we show that tidal parameter ratio (k/Q) estimates from the tidal-BYORP equilibrium are much higher than the limits calculated by estimating tidal timescales (e.g. Taylor Margot 2013). These much higher dissipation rates are validated by an analysis of two paired binary asteroids (3749 Balam and 8306 Shoko), which have known tidal timescales if pair formation is associated with binary formation. This may be indicative of much shorter lifetimes or different tidal dissipation mechanisms in the primary and secondary. Furthermore, the tidal parmaeter estimates drawn from the tidal-BYORP equilibrium do not follow the size scaling predicted from tidal theory, neither classical or Goldreich Sari (2009). Applying a newly proposed tidal model (Efroimsky, 2012, 2015), the size scaling can be matched, however the asteroid must possess a very low effective viscosity at the relevant tidal frequencies. Some hypotheses for how this all fits together will be presented at the end.