Numerical modeling of the Caloris basin. E. Martellato[1], J. Benkhoff[1], L. Colangeli[1], B. Foing[1] and S. Marchi[2, 3], [1]European Space Agency - ESTEC, Keplerlaan 1, 2201 AZ Noordwijk, The Netherlands (corresponding author: emartell@rssd.esa.int), [2]Dept Cassiopee, Université de Nice - Sophia Antipolis, Observatoire de la Côte d'Azur, CNRS, France, [3]NASA Lunar Science Institute Center for Lunar Origin and Evolution, Boulder, CO, USA.

Introduction: Mercury has remained the most enigmatic among the terrestrial planets for more than three decades (e.g., [1]), as all our knowledge has relied on the few data acquired by the NASA Mariner 10 mission. The recent Discovery mission MESSENGER acquired a so new amount of data during its three flybys with the planet and more than half a year of data acquisition from orbit that raises a new perspective into this planet.

Background on Caloris: The Caloris basin (Fig. 1), one of the most important feature of the planet, is the largest well preserved impact basin of Mercury, being its estimated diameter of about 1550 km ([2]). MESSENGER color data, observed embayment relations and the discovery of rimless depressions interpreted to be volcanic vents around Caloris, support a volcanic origin for the interior smooth plains material (e.g., [3]; [4]). According to [5], the Caloris infilling is placed after the Late Heavy Bombardment Event.

Unlike any lunar basin, Caloris also exhibits an extensive system of extensional troughs that are younger than the wrinkle ridges and display orientations that range from radial at the center to dominantly circumferential at the edge of the basin ([2]).

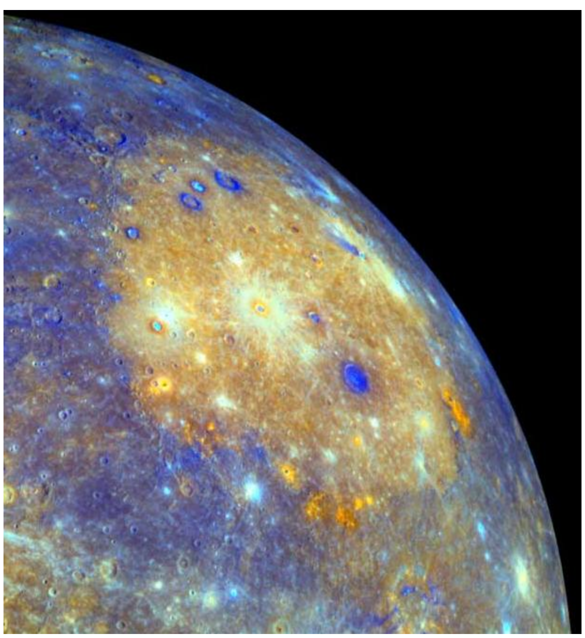

Fig. 1. An oblique color–component of the basin interior obtained from MESSENGER multispectral WAC. *Courtesy of NASA, MESSENGER database*.

The impact event itself holds an important role in the entire tectonic of the planet, as Caloris is believed not only to have affected large areas its surrounding, but also to have caused a great amount of fracturing and surface disruption at its antipode. A possible explanation is that these hilly and lineated terrains are originated by seismic waves focusing at the antipodal regions with respect to the impact (e.g., [1]).

Numerical Modeling: In this work, we will present the preliminary results regarding the numerical modeling of the Caloris basin. We used iSALE multi-material, multi-rheology shock code ([6], [7], [8], [9], [10], [11]) to simulate the impact event that gave origin to such a basin. The aim of this first study is to investigate the dependence of the basin general outcome from the internal thermal state of the planet, whose evolution has been re-evaluated in light of the new findings of the new data provided by MESSENGER [12].

Mercury is modeled as a half-space as thick as the value of its radius, i.e. 2440 km. The internal structure is set accordingly to [13], [14], and precisely, made up by an upper crust of 40 km, on top on a 600 km mantle, in turn laying above 1800 km core. The different strata are represented by basalt (ρ = 2.86 g/cc), dunite (ρ = 3.31 g/cc) and iron (ρ = 7.84 g/cc), respectively for the crust, the mantle and the core. The thermodynamic behavior of each material is described by tables generated using the Analytic Equation of State (ANEOS).

The projectile is assumed to be a basaltic object, striking the surface at 30 km/s (typical velocity on Mercury's orbit accounting for the 45° impact angle) [15].

Acknowledge: We gratefully acknowledge the developers of iSALE, including Gareth Collins, Kai Wünnemann, Boris Ivanov, Jay Melosh and Dirk Elbeshausen.

References: [1] Strom R.G. and Sprague A.L. (2003) Exploring Mercury: the iron planet, *Springer–Praxis*. [2] Murchie S.L. et al. (2008) *Science, 321, 73–76*. [3] Head J.W. et al. (2008) *Science, 321, 69–72*. [4] Watters T.R. and Nimmo F. (2010) in: Planetary Tectonics, *Cambridge Univ. Press*. [5] Massironi M. et al. (2009) *GRL, 36, L21204,1–6*. [6] Amsden A.A. et al. (1980). Los Alamos National Lab., Rep. LA–8095. [7] Collins G.S. et al. (2004) *Meteoritics & Planet. Sci., 39, 217–231*. [8] Ivanov B.A. et al. (1997)

Int. JIE, 20, 411–430. [9] Melosh H.J. et al. (1992) *JGR, 97, 14,735–14,759*. [10] Wünnemann, K. and Ivanov B.A. (2003) *SSR, 51, 831–845*. [11] Wünnemann K. et al. (2006) *Icarus, 180, 514–527*. [12] Marchi et al. *PSS, In press*. [13] Hauck S.A. et al. (2004) *EPSC, 222, 713–728*. [13] Redmond H.L. and King S.D. (2007) *PEPI, 164, 221–231*. [15] Marchi S. et al. (2005) *A&A, 431, 1123–1127*.